

# MobiWeb: Bandwidth Management for a Collaborative Information Environment

Noel Schmidt

V.P. Operations

Architecture Technology Corporation

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# Overview

- ◆ Collaborative Information Environment (CIE)
- ◆ XML Web Services
- ◆ Airborne Internet
- ◆ MobiWeb
- ◆ Aviation Extensions

# Collaborative Information Environment (CIE)



- ◆ Military: "...a 'virtual information enterprise warehouse' as a repository for information products. ... will contain timely, fused, accurate, and relevant information.... Shared battlespace awareness is achieved among multiple commands and organizations in widely dispersed geographic areas."
- ◆ Commercial: "...transforms document-based electronic information into knowledge assets by enabling users to capture, organize, find, and distribute content, providing a secure, integrated environment and intuitive interfaces that yield the riches of document experience stored in the banks of corporate memory"
- ◆ Aviation: TBD

# Extensible Markup Language (XML)



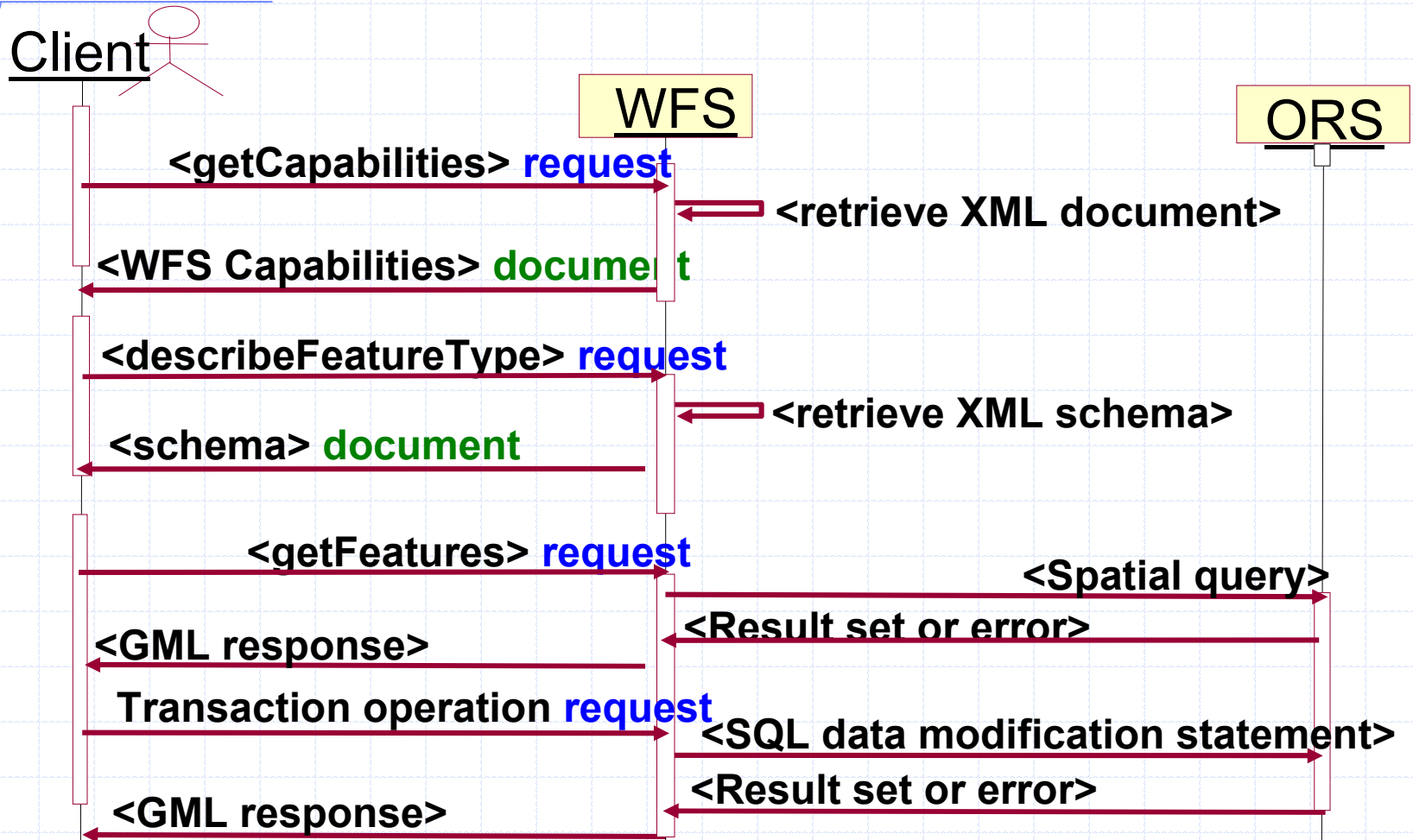
## ◆ XML the language

```
<?xml version="1.0" ?>
- <!--NAV23 flight plan-->
<!DOCTYPE FLIGHTPLAN (View Source for full doctype...)>
_ <FLIGHTPLAN TITLE="Gran Canaria - Tenerife" DESCRIPTION="GCLP, GCTS" DATE="29/10/00" AUTHOR="Anonymous"
FLIGHTPLANNERTOOL="NAV23" DESIREDFLSIM="All">
<PLANE NAME="Casa CN235" CRUISEALTITUDE="8000" DESCENTFUEL="10" CLIMBFUEL="20" CRUISEFUEL="14"
SPEEDUNITS="knots" CRUISESPEED="140" CLIMBSPEED="250" DESCENTSPEED="120" CLIMBRATE="1250"
DESCENTRATE="1250" />
<DEPARTURE TYPE="RUNWAY" ICAO="03R-21L" NAME="Pista 03R-21L" LATITUDE="27.9311930412178" LONGITUDE="-
15.3846144676208" ALTITUDE="76.9999646765041" />
```

## ◆ XML based Web Services

- Standard communication protocols (e.g. HTTP, SMTP, etc.)
- A standard data representation format (e.g., XML, SOAP)
- Standard description languages (e.g., XML Schema)
- A standard discovery mechanism (UDDI)

# Typical XML Web Service Transaction





# Potential XML Web Services

## ◆ Ground => aircraft

- Clearances, traffic advisories, turbulence reports
- Dispatcher instructions, SUA/TFR updates, service outages

## ◆ Aircraft => ground

- Position reports, maneuvering intentions, automatic PIREPS
- Maintenance data, security information, PAX services

## ◆ Aircraft => aircraft

- Position reports, visibility/icing/turbulence reports
- Traffic advisories, intents

## ◆ Internally generated (from data above)

- Course advisories, terrain warnings, SUA/TFR warnings
- Maintenance/repair actions

# Airborne Internet Concept Evolution



- ◆ SATS c.2000 - "A client-server-based architecture...to support collaborative Air Traffic Management."
- ◆ NASA c.2001 – "A communications architecture that delivers aviation information services in an Internet-like manner. Aircraft and ground facilities ... interconnected ... on a high-speed digital communications network. System architecture based on open standards and protocols."
- ◆ Airborne Internet Consortium c.2003 - "A private, secure and reliable peer-to-peer aircraft communications network that uses the same technologies as the commercial Internet."
- ◆ FAA ACB-100, c.2003 – "...an approach to provide a *general purpose, multi-application data channel* to aviation."



# Airborne Internet Architecture

- ◆ A layered set of reliable, secure, scalable, networks, protocols, and services to interchange information among distributed resources within the aviation environment.

Applications

Higher layers: Internet/Web-based applications and services to support a Collaborative Information Environment

Services/Discovery

Middle layers: service registration, discovery, and invocation.  
Information exchange and routing.

Messaging/RMI

Lower layers: common (set of) channel(s) for communication between aircraft and ground resources

Wired  
Networks

Wireless  
Networks





# The problem

## ◆ The problem

- Want: flexible, system independent data exchange
- Want: to reuse COTS technologies for information exchange
- Want: to dynamically discover/access services available
- Want: efficient use of relatively low-bandwidth data channel
- Don't want:
  - ◆ 1) Verbosity - consumes limited bandwidth
  - ◆ 2) Extensive handshaking - adds to latency
  - ◆ 3) Requirement for extensive on-board processing



# MobiWeb

## ◆ USCG Phase I, II, & III SBIR Project

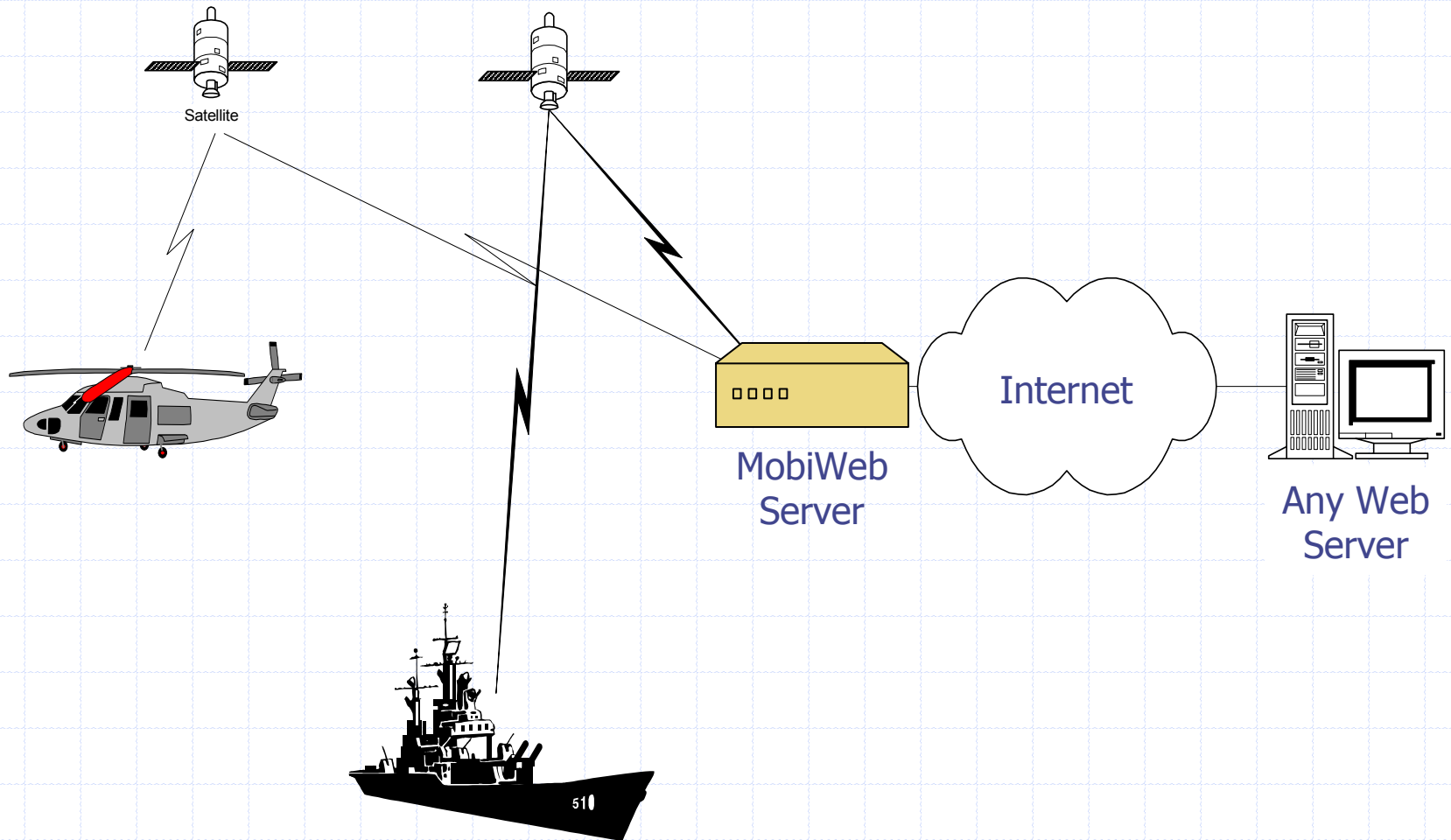
### ◆ Background

The Operational Web Link (OWL) project ... demonstrated how the Coast Guard's information collection and dissemination needs can be addressed by leveraging commercial satellite communications services and Web technology

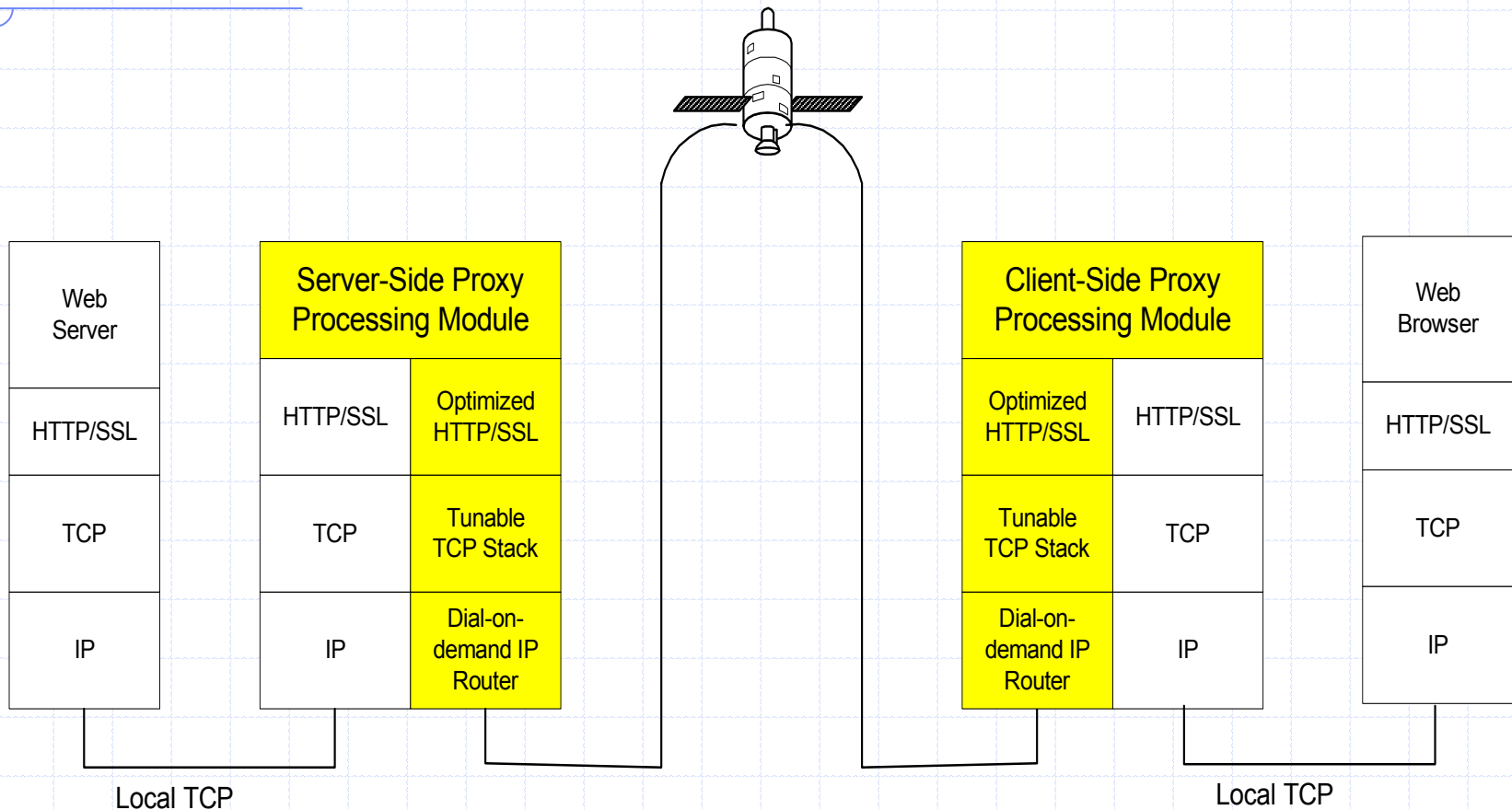
### ◆ Problem: Two major impediments to widespread deployment

- High operational costs
- Poor performance of Web applications implemented over satellite links

# USCGC Mobiweb Link



# MobiWeb Architecture

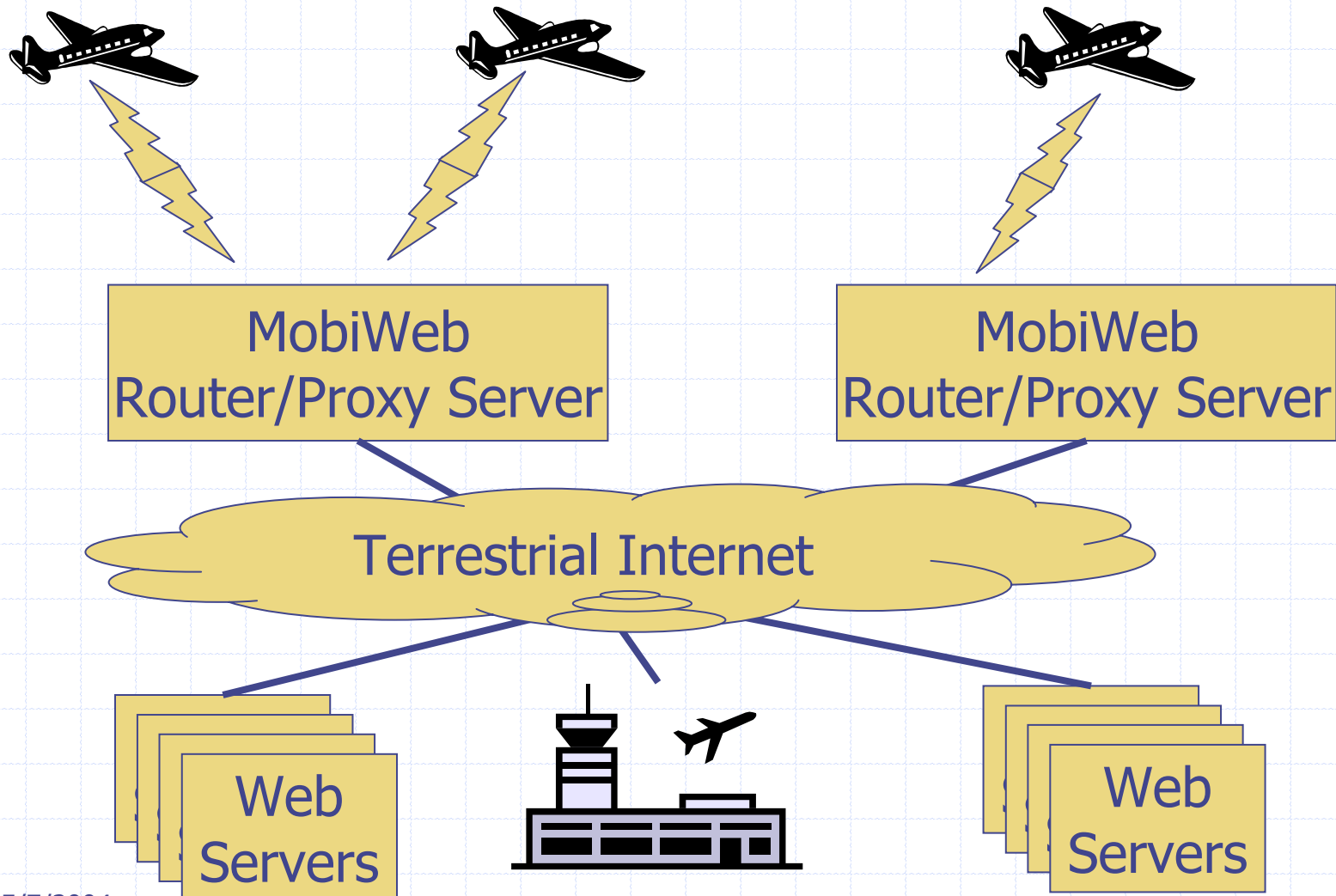




# MobiWeb Results

- ◆ In use on 20 cutters
- ◆ Uses INMARSAT, also tested on Iridium
- ◆ Geographic coverage  $\pm 70^\circ$  latitude (Inmarsat)
- ◆ Tunable TCP stack alone doubles TCP throughput
- ◆ Email proxy compression reduces email text by 75%
- ◆ Router uses an optimized connection protocol designed to operate with minimal handshaking
- ◆ Connection is shared with multiple proxies, saving connect time
- ◆ Significant savings on connection fees
- ◆ Completely transparent to the end user

# MobiWeb - Aviation Domain



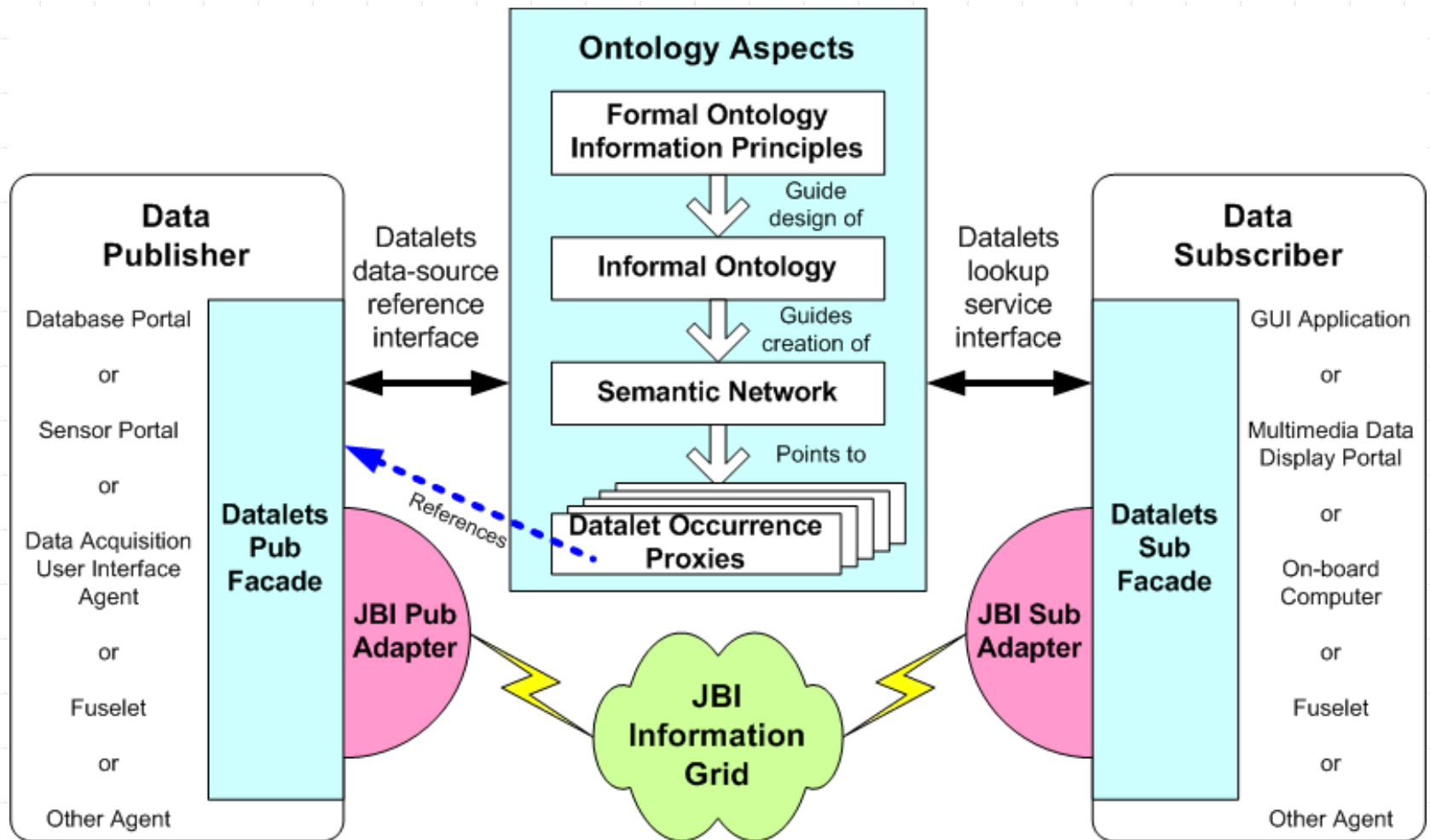
# CompreX: XML data compression



## ◆ Basic components:

- System core module
- XML compression algorithm
- Network communication module

# Datalets







# Conclusion

- ◆ Bandwidth, latency, and computational power will always be issues in aviation environments
- ◆ The collaborative information environment, XML Web services, and Airborne Internet hold promise of providing a new level of aviation services
- ◆ Technologies exist to enable early adoption of a CIE based on XML Web services despite the limitations of today's aviation data communications environment